

510 Rec'd. PCTO 24 JUN 1999

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| FORM PTO-1390 (Modified) (REV 5-93) | | U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE ATTORNEY'S DOCKET NUMBER | |
| TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371 | | 016790/0376 U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5) 09/331189 | |
| INTERNATIONAL APPLICATION NO. PCT/DE97/03015 | INTERNATIONAL FILING DATE December 23, 1997 | PRIORITY DATE CLAIMED December 24, 1996 | |
| TITLE OF INVENTION MICROSCOPE | | | |
| APPLICANT(S) FOR DO/EO/US Heinrich ULRICH and Johann ENGELHARDT | | | |
| Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information: | | | |
| <ol style="list-style-type: none"> <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. <input type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1). <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <ol style="list-style-type: none"> <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). <input checked="" type="checkbox"/> has been transmitted by the International Bureau. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US) <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371 (c)(2)). <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <ol style="list-style-type: none"> <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). <input type="checkbox"/> have been transmitted by the International Bureau. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. <input checked="" type="checkbox"/> have not been made and will not be made. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)). | | | |
| Items 11. to 16. below concern other document(s) or information included: | | | |
| <ol style="list-style-type: none"> <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. <input checked="" type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. <input type="checkbox"/> A substitute specification. <input type="checkbox"/> A change of power of attorney and/or address letter. <input type="checkbox"/> Other items or information: | | | |

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PCT/DE97/03015

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17. ☒ The following fees are submitted:**Basic National Fee (37 CFR 1.492(a)(1)-(5):**

Search Report has been prepared by the EPO or JPO \$840.00

International preliminary examination fee paid to USPTO (37 CFR 1.482)

..... \$670.00

No international preliminary examination fee paid to USPTO (37 CFR 1.482)

but international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$760.00

Neither international preliminary examination fee (37 CFR 1.482) nor

international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$970.00

International preliminary examination fee paid to USPTO (37 CFR 1.482)

and all claims satisfied provisions of PCT Article 33(2)-(4) \$96.00

ENTER APPROPRIATE BASIC FEE AMOUNT =**CALCULATIONS**

PTO USE ONLY

840.00

840.00

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30
months from the earliest claimed priority date (37 CFR 1.492(e))

| Claims | Number Filed | Number Extra | Rate | | |
|---|--------------|--------------|------------|----|------|
| Total Claims | 13 -20 = | 0 | X \$18.00 | \$ | 0.00 |
| Independent Claims | 1 -3 = | 0 | X \$78.00 | \$ | 0.00 |
| Multiple dependent claim(s) (if applicable) | | | + \$260.00 | \$ | 0.00 |

TOTAL OF ABOVE CALCULATIONS = \$ 840.00Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement
must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).**SUBTOTAL = \$ 840.00**Processing fee of \$130.00 for furnishing English translation later the ☐ 20 ☐ 30
months from the earliest claimed priority date (37 CFR 1.492(f)).**TOTAL NATIONAL FEE = \$ 840.00**Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be
accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +**TOTAL FEES ENCLOSED = \$ 840.00**Amount to be:
refunded \$

charged \$

a. ☒ A check in the amount of \$840.00 to cover the above fees is enclosed.b. ☐ Please charge my Deposit Account No. 19-0741 in the amount of \$_____ to the above fees. A duplicate copy of this sheet
is enclosed.c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any
overpayment to Deposit Account No. 19-0741. A duplicate copy of this sheet is enclosed.**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR
1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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Richard L. Schwaab

NAME

25,479

REGISTRATION NUMBER

09/331189

510 Rec'd. PCI/PTO 24 JUN-1991

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Attorney Docket No. 016790;0376

In re patent application of

Heinrich ULRICH et al.

Group Art Unit: Unassigned

Serial No. Unassigned

Examiner: Unassigned

Filed: Concurrently Herewith

For: MICROSCOPE

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination of the above-identified application, Applicants request that the following amendments be entered into the application:

IN THE CLAIMS:

Please cancel claims 1-15 and insert the following new claims

16. Confocal microscope with an optical system (2) for image rotation disposed in the path of rays (1) of the microscope, characterized in that the optical system (2) is disposed between a scanning lens (8) and a scanning mirror (9) of a beam converging lens (7) in the parallel path of rays (1) of the microscope.

17. Microscope according to claim 16, characterized in that the optical system (2) for image rotation is a prism.

18. Microscope according to claim 17, characterized in that the prism is configured as a dove prism.

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19. Microscope according to claim 17, characterized in that the prism is configured as an Abbe prism.

20. Microscope according to claim 16, characterized in that the optical system (2) for image rotation is a mirror system.

21. Microscope according to claim 20, characterized in that the mirror system is a system with an odd number of mirrors.

22. Microscope according to claim 20, characterized in that the mirror system is configured as a K mirror.

23. Microscope according to claim 16, characterized in that the optical system (2) for image rotation is disposed between the tube lens (3) and objective (4).

24. Microscope according to claim 16, characterized in that the optical system (2) for image rotation is disposed after the ocular (5) or the scan lens (8).

25. Microscope according to claim 16, characterized in that the optical system (2) for image rotation serves to rotate all scanning and video images fed through a beam converging lens (7) into the microscope.

26. Microscope according to claim 16, characterized in that the beam converging lens (7) comprises fixed thick beam splitters to avoid interferences.

27. Microscope according to claim 16, characterized in that an adjusting device is provided for minimizing the beam offset during rotation.

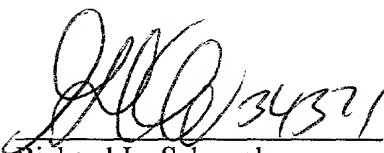
28. Microscope according to claim 16, characterized in that an axially movable objective or an axially movable objective turret is provided for the photographing of z-sections in any desired directional orientation.

REMARKS

Entry of the foregoing amendments prior to examination is respectfully requested.

Respectfully submitted,

June 24, 1999
Date


Richard L. Schwaab
Reg. No. 25,479
for

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Washington, DC 20007-8696
Tel: (202) 672-5300

Should additional fees be necessary in connection with the filing of this paper, or if a petition for extension of time is required for timely acceptance of same, the Commissioner is hereby authorized to charge Deposit Account No. 19-0741 for any such fees; and applicant(s) hereby petition for any needed extension of time.

Microscope 510 Rec'd. PCT/PTO 24 JUN 1999

The invention relates to a microscope, in particular a confocal microscope or confocal laser scanning microscope.

Conventional microscopes, and indeed confocal microscopes or confocal laser scanning microscopes as well, have been disclosed for years in the art, so it is not necessary to provide a specific description of these microscopes here. In the confocal laser scanning microscope, the beam scanning direction provides a preferred direction for the measurement or scanning. Since complicated structures - such as modern semiconductor designs - increasingly do not have rectangular structures, however, their measurement - in industry - necessitates rotating these structures or the object which is configured in such a way relative to the scanning beam.

Furthermore, for measurement purposes it may be necessary, in principle, to perform rotation of the object in order, for example, to be able to compare any desired structural features with predetermined structural patterns in the context of quantitative structural analysis. At any rate, in a wide variety of fields of application there is a fundamental requirement of being able to rotate the image as desired, for which purpose it has been necessary to rotate the object heretofore.

When the object is rotated about an arbitrary point, the object has to be rotated, on the one hand, and displaced, on the other hand, in such a way that this

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arbitrary point lies at the pivot point of the object, namely in order to obtain the center point of the image. However, the rotation and, if appropriate, simultaneous displacement of the object leads to a complex movement entailing a considerable outlay on setting.

As seen per se, an apparatus and a method for projecting images for use in television or video technology are disclosed in WO-A1-94/08425, according to which, during image projections, rotations are performed for the purpose of compensating for horizontal movements.

The present invention is based on the object, therefore, of configuring and developing a microscope, in particular a confocal microscope or confocal laser scanning microscope, in such a way that an object can be measured from a plurality of angular positions whilst avoiding rotation of the object to be measured.

The invention's microscope or confocal microscope or confocal laser scanning microscope achieves the above object by means of the features of Patent Claim 1, according to which the invention's microscope, confocal microscope or confocal laser scanning microscope is characterized by an optical arrangement for image rotation, said optical arrangement being provided in the beam path of the microscope.

The invention marks a departure, in the case of microscopes of the type discussed here, from rotating the object itself, or simultaneously displacing it in the process, in order to measure the object at different beam angles. Rather, optical rotation is now performed, namely

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by means of an optical arrangement for image rotation, said optical arrangement being provided in the beam path of the microscope, with the result that the object itself remains positioned in an unchanged manner. Consequently, repeated setting or calibration of the object is no longer necessary.

The optical arrangement for image rotation may be, for example, a prism designed in a wide variety of ways; thus, by way of example, a Dove prism or an Abbe prism. Further suitable prisms can be used for this purpose, it being essential that the prism is used as a quasi monolithic module for image rotation.

In the context of an alternative configuration of the optical arrangement for image rotation, the latter could be a mirror arrangement, preferably an arrangement with an odd number of mirrors, as is the case with the "K" mirror. More complicated configurations are conceivable here, it being necessary to take account of the fact that the light losses increase as the number of mirrors increases. In this respect, an arrangement with three mirrors presents itself as an advantageous configuration.

With regard to concrete localization of the arrangement for image rotation, it is advantageous in the context of an especially simple configuration if said optical arrangement is arranged in the parallel beam path of the microscope. Specifically, the optical arrangement for image rotation could be arranged between the tube lens and the objective, namely in the infinite beam path of the microscope.

Likewise, it would alternatively be conceivable for the optical arrangement for image rotation to be arranged downstream of the eyepiece and/or the tube lens, this resulting in inconsiderable requirements of the angular accuracy of the arrangement. In the context of such a configuration, the arrangement for image rotation would easily be able to be retrofitted. The requirement of synchronous rotation of the two eyepieces would certainly be disadvantageous in this case.

In the context of a further configuration option, the optical arrangement for image rotation could serve for rotating all the scanned and video images fed into the microscope by a laser scanner. To that end, the optical arrangement for image rotation could be arranged between a scanning lens and a scanning mirror of the laser scanner. This configuration is advantageous in so far as here there is a substantially smaller degree of angular sensitivity, as exists when the rotor is arranged between tube lens and objective.

In order to avoid interference when coherent light sources are used, the laser scanner could have stationary beam splitters which are sufficiently thick or sufficiently wedge-shaped, with the result that the internal reflections of the original beams run in a manner spatially separated from the original beams. Interference phenomena are thereby suppressed.

Furthermore, a separate adjustment apparatus could be provided for the purpose of minimizing the beam offset during rotation of the arrangement.

Finally, in a further advantageous manner, provision is made of an axially moveable objective and/or an axially moveable objective turret for taking z-sections in arbitrarily oriented directions.

There are, then, a variety of possibilities for configuring and developing the teaching of the present invention in an advantageous manner. To that end, reference is made on the one hand to the claims which are subordinate to Patent Claim 1, and on the other hand to the following explanation of three exemplary embodiments of the invention with reference to the drawing. In conjunction with the explanation of the preferred exemplary embodiment of the invention, in general preferred configurations and developments of the teaching will also be explained. In the drawing,

Fig. 1 shows, in a schematic side view, a first exemplary embodiment of a microscope according to the invention with an optical arrangement for image rotation,

Fig. 2 shows, in a schematic side view, a second exemplary embodiment of a microscope according to the invention with an optical arrangement for image rotation,

Fig. 3 shows, in a schematic side view, a third exemplary embodiment of a microscope according to the invention with an optical arrangement for image rotation.

Fig. 1 shows a first exemplary embodiment of a microscope according to the invention with an arrangement

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2 for image rotation which is provided in the beam path 1 of the microscope.

In the case of the exemplary embodiments which are illustrated in the figures, the arrangement 2 for image rotation is - for the sake of a simple illustration - a "K" mirror arranged at different locations in the beam path 1 of the microscope.

In the case of the illustration shown in Fig. 1, the arrangement 2 is arranged between the tube lens 6 and the objective 4, which will certainly give rise to a problem in terms of retrofitting capability.

In accordance with the illustration in Fig. 2, the arrangement 2 for image rotation is arranged downstream of the eyepiece 3 and the tube lens 6. In this respect, the resulting requirements of the angular accuracy of the arrangement in Figure 1 are substantially less stringent. Moreover, this arrangement can easily be retrofitted, the requisite synchronous rotation for the two eyepieces 3 being problematic or disadvantageous in terms of the handling of the microscope.

In the case of the microscope illustrated in Fig. 3, the optical arrangement 2 for image rotation serves for rotating all the scanned and video images fed into the microscope by a laser scanner 7. Specifically, the optical arrangement 2 for image rotation is arranged between a scanning lens 8 and a scanning mirror 9 of the laser scanner 7.

With regard to further embodiments on the one hand of a concrete configuration of the arrangement 2 for

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image rotation and on the other hand with regard to further measures relating to adjustment for the purpose of minimizing the beam offset or relating to axial mobility of the objective and/or of the objective turret, reference is made to the general part of the description in order to avoid repetition.

In conclusion, it shall be especially emphasized that the exemplary embodiments discussed above serve to provide an understanding of the teaching that is claimed here, but do not restrict said teaching to the exemplary embodiments.

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Patent Claims

1. Microscope, in particular confocal microscope, characterized by an optical arrangement (2) for image rotation, said optical arrangement being provided in the beam path (1) of the microscope.
2. Microscope according to Claim 1, characterized in that the optical arrangement (2) for image rotation is a prism.
3. Microscope according to Claim 2, characterized in that the prism is designed as a Dove prism.
4. Microscope according to Claim 2, characterized in that the prism is designed as an Abbe prism.
5. Microscope according to Claim 1, characterized in that the optical arrangement (2) for image rotation is a mirror arrangement.
6. Microscope according to Claim 5, characterized in that the mirror arrangement is an arrangement with an odd number of mirrors.
7. Microscope according to Claim 5 or 6, characterized in that the mirror arrangement is designed as a "K" mirror.
8. Microscope according to one of Claims 1 to 7, characterized in that the optical arrangement (2) for image rotation is arranged in the parallel beam path (1) of the microscope.
9. Microscope according to Claim 8, characterized in that the optical arrangement (2) for image rotation is arranged between tube lens (6) and objective (4).

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10. Microscope according to Claim 8, characterized in that the optical arrangement (2) for image rotation is arranged downstream of the eyepiece (3) and/or the tube lens (6).

11. Microscope according to one of Claims 1 to 10, characterized in that the optical arrangement (2) for image rotation serves for rotating all the scanned and video images fed into the microscope by a laser scanner (7).

12. Microscope according Claims 11, characterized in that the optical arrangement (2) for image rotation is arranged between a scanning lens (8) and a scanning mirror (9) of the laser scanner (7).

13. Microscope according to Claim 11 or 12, characterized in that the laser scanner (7) comprises stationary beam splitters which are sufficiently thick or sufficiently wedge-shaped for the purpose of avoiding interference.

14. Microscope according to one of Claims 1 to 13, characterized in that an adjusting apparatus is provided for the purpose of minimizing the beam offset during rotation.

15. Microscope according to one of Claims 1 to 14, characterized in that provision is made of an axially moveable objective and/or an axially moveable objective turret for taking z-sections in arbitrarily oriented directions.

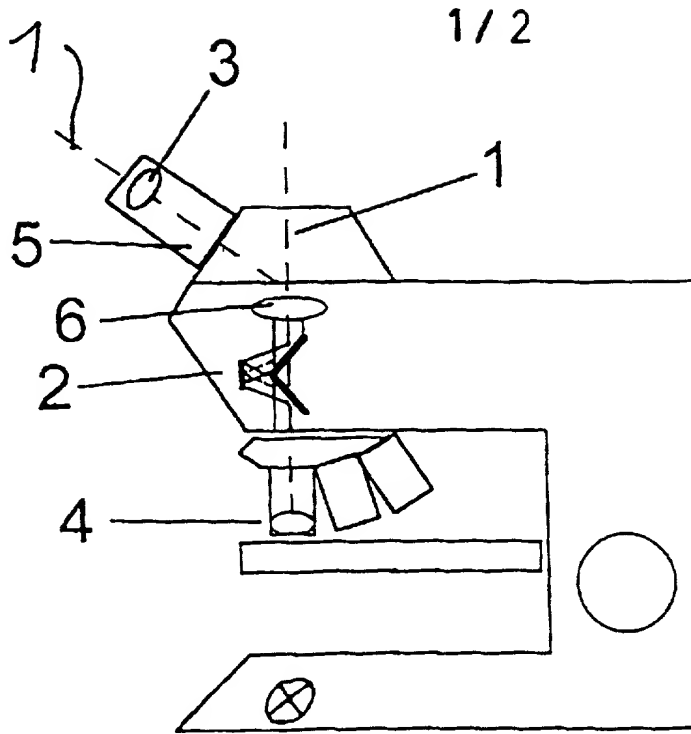


Fig. 1

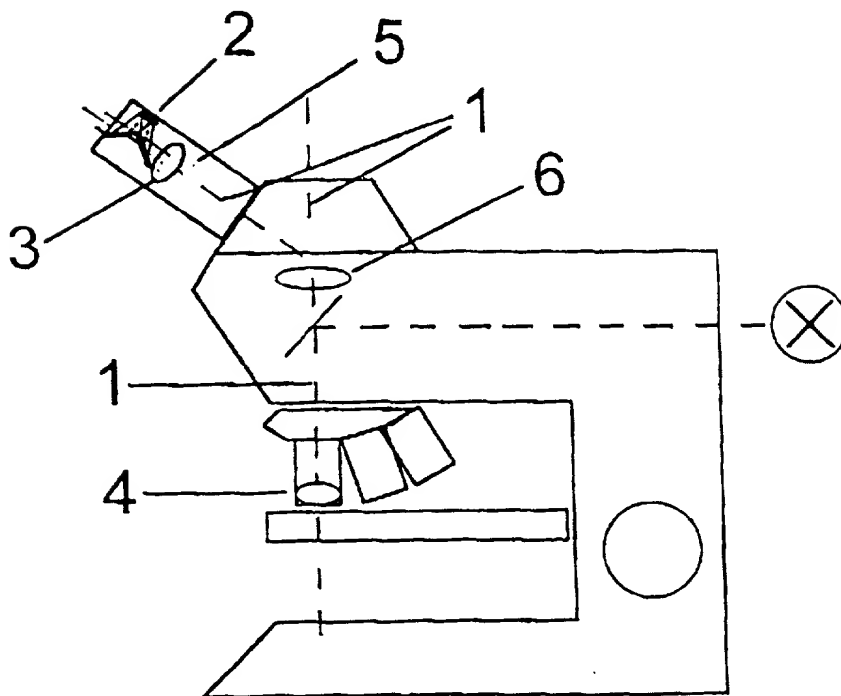


Fig. 2

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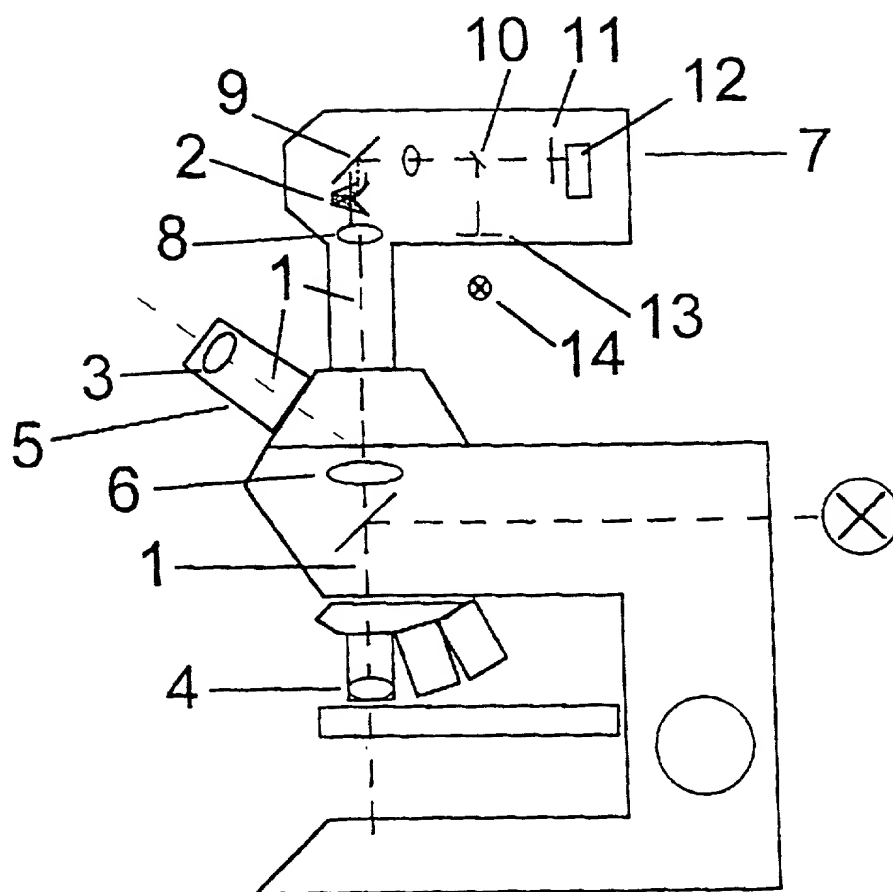


Fig. 3

DECLARATION AND POWER OF ATTORNEY

E-03174

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

MICROSCOPE

the specification of which is attached hereto unless the following box is checked:

☒ was filed on December 23, 1997 as United States Application Number or PCT International Application Number PCT/DE97/03015 and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is known by me to be material to patentability as defined in Title 37, Code of Federal Regulations § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

| NUMBER | COUNTRY | DAY/MONTH/YEAR FILED | PRIORITY CLAIMED |
|---------------------|-----------------------------|-------------------------|------------------|
| <u>196 54 208.1</u> | <u>FED. REP. OF GERMANY</u> | <u>24/December/1996</u> | <u>Yes</u> |
| | | | |
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| | | | |

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below.

| APPLICATION NO. | FILING DATE |
|-----------------|-------------|
| | |
| | |
| | |

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is known by me to be material to patentability as defined in Title 37, Code of Federal Regulations § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

| APPLICATION SERIAL NO. | FILING DATE | STATUS: PATENTED, PENDING, ABANDONED |
|------------------------|-------------|--------------------------------------|
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I hereby appoint as my attorneys, with full powers of substitution and revocation, to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Stephen A. Bent, Reg. No. 29,768; David A. Blumenthal, Reg. No. 26,257; William T. Ellis, Reg. No. 26,874; John J. Feldhaus, Reg. No. 28,822; Patricia D. Granados, Reg. No. 33,683; John P. Isaacson, Reg. No. 33,713; Michael D. Kaminski, Reg. No. 32,904; Kenneth E. Krohn, Reg. No. 25,735; Glenn Law, Reg. No. 34,371; Eugene M. Lee, Reg. No. 32,039; Richard Linn, Reg. No. 25,144; Peter G. Mack, Reg. No. 26,001; Brian J. McNamara, Reg. No. 32,789; Sybil Meloy, Reg. No. 22,749; Richard C. Peet, Reg. No. 35,792; George E. Quillin, Reg. No. 32,792; Colin G. Sandercock, Reg. No. 31,298; Bernhard D. Saxe, Reg. No. 28,665; Charles F. Schmitt, Reg. No. 27,590; Richard L. Schwaab, Reg. No. 25,479; Arthur Schwartz, Reg. No. 22,115; Harold C. Wegner, Reg. No. 25,258.

Address all correspondence to **FOLEY & LARDNER**, 3000 K Street, N.W., Suite 500, Washington, DC 20007-5109. Address telephone communications to Richard L. Schwaab at (202) 672-5300.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

| | | |
|---|---|-------------------------|
| Full Name of First or Sole Inventor <u>Heinrich ULRICH</u> | Signature of First or Sole Inventor <u>Heinrich Ulrich</u> | Date <u>08/05/99</u> |
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